



State of New Hampshire
RECOMMENDATIONS FOR THE
PREVENTION AND CONTROL of
MULTIDRUG-RESISTANT ORGANISMS (MDROs)
for Healthcare Agencies and Community Settings

Prepared by

New Hampshire Communicable Disease Epidemic Control Committee

Revised: 15 March 2008

TABLE OF CONTENTS

NH COMMUNICABLE DISEASE EPIDEMIC CONTROL COMMITTEE (CDECC) MEMBERS	3
TELEPHONE CONTACT LIST	4
ABBREVIATIONS USED IN THIS DOCUMENT	5
DEFINITIONS	6
I. INTRODUCTION	8
A. Background	8
B. Purpose	10
C. Process	10
D. Assumptions	10
E. NH DHHS Role and Responsibilities	11
Table 1. Examples of Clinically Relevant MDROs	12
II. RECOMMENDATIONS.....	12
A. Priority Activities	12
B. The Prevention of Emergence of MDROs	13
1. Judicious Use of Antimicrobial Agents	13
C. The Prevention of Transmission of Organisms from Person to Person	13
1. Administrative Measures.....	13
2. Infection Control Measures	14
3. Environmental Measures	20
4. Setting Specific Recommendations.....	20
D. The Prevention of Infection by MDROs	23
1. Education and Communication	24
2. Surveillance	24
3. Decolonization	25
4. Animals and MDROs in Hospital Healthcare Settings	26
III. MDRO Outbreak Management	26
REFERENCES	28
APPENDIX: Two-Tiered Approach to MDRO Control	

NH COMMUNICABLE DISEASE EPIDEMIC CONTROL COMMITTEE (CDECC) MEMBERS

Christine Adamski, RN NH DHHS Communicable Disease Surveillance	Margaret Franckhauser, RN, MS, MPH Executive Director Community Health & Hospice, Inc.
Phil Alexakos, MPH REHS Manchester Health Department	Curtis Metzger, BSW, M.Div NH DOS Homeland Security & Emergency Mgmt
Christine Bean, PhD NH DHHS Public Health Laboratories	Jose T. Montero, MD NH DHHS State Epidemiologist
Kathy Bizarro NH Hospital Association	Darlene Morse, RN, M.Ed, CHES NH DHHS Communicable Disease Control
David Blaney, MD Epidemic Intelligence Service Officer	Sue Prentiss Bureau of EMS
Lynda Caine, RN, MPH, CIC Elliot Hospital	Jan Puffer RN, MA, CIC *
Elizabeth Clark, MD Infectious Disease Associates	NH DHHS Communicable Disease Control
Steven Crawford, DVM State Veterinarian	Rachel Rowe, RN*
Elizabeth Daly, MPH* NH DHHS Communicable Disease Surveillance	Foundation for Healthy Communities
Paul Etkind, DrPH, MPH Nashua Health Department	Jody Smith, MPH NH DHHS Communicable Disease Control
Robert Gougelet, MD Dartmouth-Hitchcock Medical Center	Jason Stull, VMD, MPVM NH DHHS Communicable Disease Control
Jennifer Harper NH DOS Homeland Security & Emergency Mgmt	Elizabeth A. Talbot, MD Dartmouth-Hitchcock Medical Center
Kathryn Kirkland, MD Dartmouth-Hitchcock Medical Center	Daniel Tullo, MS SM (ASCP) NH DHHS Public Health Laboratories
Jane Manning, MPH NH DHHS Communicable Disease Control	Diane Viger, MPH, BSN, RN-BC, CPHQ, CIC NH Hospital
	Nicola Whitley, MS NH DHHS Public Information Office
	Bill Wood Bureau of EMS

*Other subject matter experts by invitation

We also extend our appreciation to the many individuals and community partners who gave generously of their time and effort in the development of the recommendations and our dedicated staff from the Communicable Disease Control and Surveillance Sections.

Point Of Contact: José Thier Montero, MD
State Epidemiologist, NH DHHS
jmontero@dhhs.state.nh.us
603-271-4477

TELEPHONE CONTACT LIST

Organization	Telephone number
Berlin Health Department	(603) 752-1272
CDC Emergency Response	(770) 488-7100
DHHS Communicable Disease Control Section	(603) 271-4496
DHHS Communicable Disease Surveillance Section	(603) 271-0279
DHHS Director, Division of Public Health Services	(603) 271-4501
DHHS Health Officer Liaison	(603) 271-4781
DHHS Public Health Laboratories	(603) 271-4661
DHHS Public Information Office	(603) 271-4822
DHHS State Epidemiologist	(603) 271-4477
Manchester Health Department	(603) 624-6466
Nashua Public Health and Community Services	(603) 589-4560
NH Homeland Security and Emergency Management (HSEM)	(603) 271-2231 or (800) 852-3792
NH Hospital Association	(603) 225-0900
NH Medical Society	(603) 224-1909
NH Department of Education School Health Services Consultant	(603) 271-3891

ABBREVIATIONS USED IN THIS DOCUMENT

AIIR	Airborne Infection Isolation Room
ASC	Active Surveillance Cultures
CA MDRO	Community Associated Multidrug-Resistant Microorganisms
CDCS	NH DHHS, Communicable Disease Control Section
CDSS	NH DHHS, Communicable Disease Surveillance Section
CDC	U.S. Centers for Disease Control and Prevention
CDECC	NH Communicable Disease Epidemic Control Committee
CSTE	Council of State and Territorial Epidemiologists
DHHS	NH Department of Health and Human Services
DPHS	Division of Public Health Services
EPA	Environmental Protection Agency
ESBL	Extended-spectrum beta-lactamase-producing gram negative bacilli
GI	Gastrointestinal
GNB	Gram negative bacilli
GU	Genitourinary
HAI	Healthcare-associated Infection
HCW	Healthcare Worker
HSEM	NH Homeland Security and Emergency Management
ICP	Infection control professional
ICU	Intensive care unit
IV	Intravenous
LTCF	Long-term care facility
MDRO	Multidrug-Resistant Organism
MDRSP	Multidrug-Resistant <i>Streptococcus pneumoniae</i>
MHD	Manchester Health Department
MRSA	Methicillin-resistant <i>Staphylococcus aureus</i>
MSSA	Methicillin-susceptible <i>Staphylococcus aureus</i>
NH	New Hampshire
NHICEP	NH Infection Control and Epidemiology Professionals
NIOSH	The National Institute for Occupational Safety and Health
PHL	DHHS, Public Health Laboratories
PIO	DHHS, Public Information Office
PPE	Personal protective equipment
SHEA	Society for Healthcare Epidemiology of America
VISA	Vancomycin intermediate-resistant <i>Staphylococcus aureus</i>
VRE	Vancomycin-resistant <i>Enterococci</i>
VRSA	Vancomycin-resistant <i>Staphylococcus aureus</i>
WHO	World Health Organization

DEFINITIONS

Carrier: An individual who has been found to be colonized at one or more body sites but who has no signs or symptoms of infection.

Cluster: A closely grouped series of cases of a disease with well-defined distribution patterns in relation to time and/or place.

Cohort: A cohort consists of two or more patients sharing the same room in a facility and/or physically separated from other patients by their location.

Cohort staffing: The practice of assigning specified personnel to care only for patients known to be colonized or infected with MDROs

Colonization: The presence of microorganisms in or on a host with growth and multiplication but without tissue invasion or damage.

Community-associated infection: an infection resulting from an exposure to a source in the community, outside of a healthcare setting and generally without healthcare risk factors within the past year such as hospitalization, surgery, or placement of a permanent medical device.

Containment measures: The separation of infected or exposed persons from non-infected persons by use of isolation, quarantine, or other restrictions on movement and activities.

Cooperative: Able and willing to understand and execute instructions.

Decolonization therapy: Topical and/or systemic antibiotic treatment administered for the purpose of eliminating carriage in an individual.

Disinfection: A process that kills or destroys nearly all microorganisms, with the exception of bacterial spores, on inanimate objects.

Empiric: Actions based on experience.

Endemic: A baseline rate or an ongoing frequency at which MDROs infection or colonization occurs in a facility.

Epidemic: An increase in the incidence of MDROs above its expected endemic level of occurrence in a given facility, which may signify an outbreak, is occurring.

Epidemiologically important organism: Any organism transmitted in a healthcare setting that becomes targeted for control because it is or has become epidemiologically important. In determining what constitutes an “epidemiologically important organism”, the following characteristics apply:

- A propensity for transmission within healthcare facilities based on published reports and the occurrence of temporal or geographic clusters of > 2 patients. A single case of healthcare-associated invasive disease caused by certain pathogens is generally considered a trigger for investigation and enhanced control measures because of the risk of additional cases and severity of illness associated with these infections.
- Antimicrobial resistance to first-line therapies are difficult to treat because of innate or acquired resistance to multiple classes of antimicrobial agents.
- Common and uncommon microorganisms with unusual patterns of resistance within a facility.
- Association with serious clinical disease, increased morbidity and mortality

- A newly discovered or reemerging pathogen

Healthcare-associated infection: An infection that develops in a patient who is cared for in any setting where healthcare is delivered (e.g., acute care hospital, chronic care facility, ambulatory clinic, dialysis center, surgicenter, home) and is related to receiving health care (i.e., was not incubating or present at the time healthcare was provided). In ambulatory and home settings, HAI would apply to any infection that is associated with a medical or surgical intervention performed in those settings.

Healthcare personnel: Refers to any person who has close occupational contact of 1) patients (e.g., within 3 feet), 2) patient-care areas (e.g., patient rooms, procedure areas), or 3) patient-care items (e.g., linens and other waste).

Hospital-associated infection: refer to healthcare-associated infection; an infection resulting from an exposure to a source within a hospital that was not incubating at the time of admission.

Immunocompetence: The capacity for a normal immune response.

Infection: The invasion of bacteria into a body site, multiplying in tissue, and accompanied by clinical signs of illness such as fever, elevated white blood count, purulence (pus), pneumonia, and inflammation (warmth, redness, swelling). It may be documented by positive cultures such as blood, sputum, wound, or urine.

Infection control measures: Measures practiced by healthcare personnel in healthcare facilities to decrease the risk for transmission and acquisition of infectious agents through proper hand hygiene, scrupulous work practices, and use of personal protective equipment, such as masks, gloves, gowns, and eye protection. The types of infection control measures are based on how an infectious agent is transmitted and include standard, contact, droplet, and airborne precautions. Additional information can be found at: http://www.cdc.gov/ncidod/dhqp/gl_isolation.html (23).

Isolation: The separation of persons with a specific contagious illness from contact with susceptible persons and the restriction of their movement to reduce exposure to infected persons. Isolation may be used voluntarily or compelled by public health authorities and usually occurs in a hospital but can be in a home or dedicated isolation facility.

Line listing: A list of persons with a particular disease. The list often contains specific information about each person such date of onset, clinical information, and treatment information. The information is typically formatted in a table such that each row represents a person and the row is divided into multiple columns used to track the specific information for each person. The list is often maintained during outbreaks to help track those affected.

Multidrug-resistant organisms: Bacteria that have become resistant to one or more classes of antimicrobial agents and usually are resistant to all but one or two commercially available antimicrobial agents. Common examples include MRSA, VISA/VRSA, VRE, ESBLs and MDRSP (See list of abbreviations on page 6 & 7).

Non-hospital healthcare setting: Includes any setting where healthcare is delivered that is not a hospital, which may include EMS settings (e.g., ambulances), patient homes, long-term care (e.g., nursing homes, assisted living facilities), skilled nursing facilities, hemodialysis centers, residential schools, psychiatric hospitals, and physicians' offices.

Nosocomial infection: refer to “healthcare-associated infection.” The term “nosocomial infection” refers to any infection that develops during or as a result of an admission to an acute care facility (hospital) and was not incubating at the time of admission.

Outbreak: An increase in the incidence of MDROs in the facility above the baseline level, for which a common source (e.g., medical device) or common transmission route (e.g. person-to-person) is likely.

Personal protective equipment (PPE): Barrier protection to be used by an individual to prevent disease transmission. PPE may include gowns, gloves, masks, goggles, or face shields. The type of mask (e.g., surgical or N95) is disease-specific and defined in the type of precautions.

Reservoir: A person, animal, organism, or substance in which an infectious agent lives and multiplies (usually without damaging its host) that is a source of infection to a susceptible host.

Risk factor: A characteristic that is associated with an increased occurrence of disease or other health-related event.

Surveillance: The systematic collection, analysis, interpretation, and dissemination of data on an ongoing basis, to gain knowledge of the pattern of disease or event occurrence in a population in order to control and prevent disease in that population.

Three C’s: A framework of prevention principles: Ensure that the patient is *clean*, with drainage, secretions, and excretions *contained*, and is *cooperative* in any setting.

I. INTRODUCTION

A. Background

Multi-drug resistant organisms (MDRO) are defined as bacteria that have become resistant to one or more classes of antimicrobial agents and usually are resistant to all but one or two commercially available antimicrobial agents. Common examples include MRSA, VISA/VRSA, VRE, ESBLs and MDRSP. The emergence of multidrug-resistant organisms (MDROs) is increasingly recognized as a major public health threat. MDROs of clinical concern include methicillin-resistant *Staphylococcus aureus* (MRSA), *Staphylococcus aureus* with resistance to vancomycin (VISA/VRSA), vancomycin-resistant *Enterococci* (VRE), extended-spectrum beta-lactamase-producing gram-negative bacilli (ESBLs), and multidrug-resistant *Streptococcus pneumoniae* (MDRSP). The escalating prevalence of MDROs over the last two decades poses several problems:

- Patients and residents with infections caused by MDROs are more likely to require hospitalization, with increased costs and lengths of stay, and adversely affected prognoses (1-3).
- MDROs can spread to other patients and to healthcare workers.
- There is the potential transfer of resistance to other microorganisms.

MDROs are increasingly common in healthcare facilities. The prevalence of MDRO’s in healthcare facilities varies temporally, geographically, and by facility type. For example, studies have shown that intensive care units (ICUs) may have a higher prevalence of MDRO infections than non-ICU settings (4,5). Additionally, the role of long-term care facilities (LTCF) may be important since residents may serve as reservoirs and vehicles for MDRO introduction into acute care facilities (6-8). Studies have also shown that more than 20% of long-term care facility (LTCF) residents may be colonized with MRSA, and more than 10% may be colonized with VRE (9-11). In addition to

MRSA and VRE, antibiotic-resistant gram-negative bacilli (GNB) are also common in these settings (e.g., *E. coli*, *Pseudomonas aeruginosa*, *Klebsiella* species) (12). In NH, MDROs have been identified in all healthcare settings and the general community.

There are known risk factors for both colonization and infection with healthcare-associated MDROs including the following:

- Severity of illness
- Previous exposure to antimicrobial agents
- Underlying disease or conditions, particularly
 - Chronic renal disease
 - Insulin-dependent diabetes mellitus
 - Immunodeficiency
 - Peripheral vascular disease
- Advanced age (>65)
- Previous colonization with a multidrug resistant organism
- High patient-to-staff ratio in the facility
- Decline in functional status
- Repeated hospital admissions and other contacts with the healthcare system
- Invasive procedures such as
 - Dialysis
 - Presence of invasive devices
 - Urinary catheterization
- Wounds, dermatitis, or skin lesions
- Lack of attention to basic infection control measures in the facility

MDROs are not limited to healthcare facilities. Community-associated MRSA is the most commonly identified CA-MDRO and community transmission has been well documented in recent years. Investigations have shown transmission among inmates, athletes, military recruits, and daycare attendees (13-16). The spectrum of disease caused by CA-MRSA appears to be similar to that of methicillin-susceptible *Staphylococcus aureus* (MSSA) in the community. Skin and soft tissue infections (SSTIs), are the most frequently reported clinical manifestations accounting for an estimated 77% of CA-MRSA infections (17); one study of purulent SSTI's in adult emergency department patients found that 59% were caused by MRSA (18). Less commonly, CA-MRSA has been associated with severe and invasive staphylococcal infections, including pneumonia, bacteremia, musculoskeletal infections, and necrotizing fasciitis (18). Invasive manifestations can occur as complications of a preceding SSTI or respiratory tract infection (particularly influenza), and sometimes occur in otherwise healthy persons without recognized preceding infections or risk factors (17). A recent population based study estimated the rate of invasive community-associated MRSA infections in the U.S. to be 4.6 infections per 100,000 persons resulting in 0.5 deaths per 100,000 (19).

Recent studies and outbreak investigations have identified the following risk factors for infection with community-associated MRSA (13-16):

- Living, working, or spending time in crowded conditions (i.e., institutional settings).
- Coming into frequent contact with others (i.e., sports team participation).
- Recent antimicrobial use (generally in the three months preceding infection).

- Compromised skin (i.e., lesions and other open cuts or wounds).
- Contaminated surfaces and shared items.
- Cleanliness (poor personal hygiene).

B. Purpose

The purpose of this document is the following:

- To provide guidance on the prevention and management of MDROs that occur in healthcare settings and the community.
- To control MDROs in NH while maintaining quality of life for those patients/residents who are colonized or infected with MDROs.
- To assist NH healthcare professionals in making informed decisions within the context of their practice setting and given patient population.
- To facilitate patient movement across levels of care throughout the healthcare system.
- To provide a consistent Statewide approach to MDRO control to improve adherence and reinforce patient/family confidence. There should be no fundamental differences in practice across the State and in different healthcare settings.

C. Process

This document is an update to the *NH Recommendations for the Prevention and Control of Multidrug-Resistant Organisms* originally produced in 2004. These updated guidelines were drafted by the Communicable Disease Control Section (CDCS) with input from the NH Communicable Disease Epidemic Control Committee (CDECC), which consists of representatives from the two local health departments, physicians specializing in infectious diseases and epidemiology, representatives from the Homeland Security and Emergency Management (HSEM), the State Epidemiologist, other officials from DHHS, and partners such as the NH Hospital Association. The final recommendations were modeled on Centers for Disease Control and Prevention (CDC) guidance, other State guidelines, and the Society for Healthcare Epidemiology of America (SHEA) Guidelines (20). It is anticipated that this document may undergo future revisions as situations in the State change and as guidance from CDC is updated. It will be reviewed regularly by the NH CDECC and revised as appropriate.

D. Assumptions

The development of the *NH Recommendations for the Prevention and Control of Multidrug-Resistant Organisms* was based on the following assumptions:

- There is evolving consensus regarding the best way to control MDROs, but there are also still controversies.
- Methods for surveillance of MDRO colonization and infection are imperfect, and those persons identified with an MDRO likely represent a small proportion of the total number of persons who have MDROs.

- Measures appropriate in outbreak settings may differ from those for non-outbreak settings.
- Reference to “patient” can be inferred to also be relevant for LTCF residents unless otherwise specified.
- The scope of this document is not intended to address management of persons infected with multidrug-resistant *Mycobacterium tuberculosis* (MDR-TB). To request guidance or to report a case of MDR-TB, please contact the NH Tuberculosis Program at 603-271-4496.

It is also assumed that every NH facility should have its own comprehensive approach to MDRO control according to the infection control and surveillance recommendations in this document. Such a comprehensive approach should also address topics that are not the emphasis of this document, such as:

- Strategy for institution of and adherence to the infection control measures described in this document;
- Education for healthcare workers (HCWs), staff, patients, and visitors;
- Local communication objectives and methods;
- Institutional antibiotic use guidelines to minimize unnecessary antibiotic use and mandate the appropriate use of vancomycin (21,22).

E. NH DHHS Role and Responsibilities

The role of NH DHHS is to provide recommendations to help control the emergence of MDROs and to identify and respond to MDRO-related threats to NH citizens.

Responsibilities of NH DHHS include the following:

- Encourage education and training for healthcare providers and communities.
- Provide and update recommendations as appropriate.
- Advise regarding any changes to the Reportable Disease List (currently, VRE, VRSA, and “any unusual occurrence or cluster of illness which may pose a threat to the public’s health” are included, but this List is subject to review and change).
- Provide data and statistical reports on the occurrence of reportable MDROs in NH.
- Track and respond to outbreaks of MDROs.
- Local and regional health departments will conduct educational campaigns for MDRO prevention.

Table 1. Examples of Clinically Relevant MDROs

MDRO	Agent	Reservoir	Mode of Transmission	Comments
MRSA	Methicillin-resistant <i>S. aureus</i>	Colonized and infected patients Colonized HCWs Environment and fomites (24)	Person-to-person HCW hands Environment	CA-MRSA infections most often present as skin infections Now endemic in most U.S. hospitals Most invasive MRSA infections are HA-MRSA MRSA colonized patients more likely to develop symptomatic infection than those with MSSA (25,26)
VISA VRSA	Vancomycin-(intermediate/resistant) <i>S. aureus</i>	Colonized and infected patients Colonized HCWs Environment and fomites (24)	Person-to-person HCW hands Environment	VISA and VRSA rare in the U.S. Prolonged vancomycin use is risk factor
VRE	Vancomycin-resistant <i>Enterococcus faecalis</i> or <i>faecium</i>	GI, GU, and environment	Person-to-person HCW hands Environment	Often multi-resistant to penicillins and aminoglycosides
ESBL	Extended-spectrum Beta Lactamase-producing GNB	GI LTCF particular concern as reservoir for acute care facilities	Person-to-person HCW hands Environment	Important ESBL GNB include <i>Klebsiella</i> , <i>Pseudomonae</i> , <i>Serratia</i>
MDRSP	Multidrug-resistant <i>S. pneumoniae</i>	Nasopharynx	Direct contact Droplet spread	MDRSP often resistant to penicillin, erythromycin, trimethoprim - sulfamethoxazole, fluoroquinolones

II. RECOMMENDATIONS

A. Priority Activities

Preventing infections and antimicrobial resistance depends on appropriate practices incorporated throughout all levels of care. There is no single approach applicable to all healthcare settings. The CDC Campaign to Prevent Antimicrobial Resistance in Healthcare Setting that was launched in 2002 provides evidenced-based principles and tools for implementation (<http://www.cdc.gov/drugresistance/healthcare/>). Studies have shown MDROs can be controlled, but successful outcomes are usually based on multiple interventions (27). These have been

grouped into 7 main categories of priority activities to focus control measures and organized under three main goals of preventing infections and antimicrobial resistance. These are:

- The Prevention of Emergence of MDROs
 - Judicious use of Antimicrobial Agents
- The Prevention of Transmission of Organisms from Person to Person
 - Administrative Measures
 - Infection Control Measures
 - Environmental Measures
- The Prevention of Infection by MDROs
 - Education and Communication
 - Surveillance
 - Decolonization

B. The Prevention of Emergence of MDROs

1. Judicious Use of Antimicrobial Agents

Antibiotic stewardship is best accomplished through an organizational, multidisciplinary antimicrobial management program (27). Optimal treatment of infections and appropriate antibiotic use is the goal. Limiting antimicrobial use as a single strategy may not control resistance.

Materials and resources generated by national programs can be found at the following web sites:

<http://www.cdc.gov/drugresistance/healthcare/> and <http://www.cdc.gov/drugresistance/community/>

Efforts should also focus on:

- Effective treatment of infections, not contaminants.
- Use of narrow spectrum agents and restricting use of broad-spectrum or more potent antimicrobials for serious infections when the pathogen is not known or other effective agents are unavailable.
- Review of antimicrobial utilization, local susceptibility patterns (antibiograms).
- Avoiding excessive duration of therapy.
- Strategies for influencing antimicrobial prescribing patterns (formulary restrictions, stop orders, computer-assisted management programs etc.).

C. The Prevention of Transmission of Organisms from Person to Person

1. Administrative Measures

Approaches to the prevention and control of MDROs should be tailored to the specific needs and characteristics of each population and healthcare setting. Administrative leadership and commitment to preventing transmission is essential to ensure programs and strategies are fully implemented and regularly evaluated. Key administrative measures include:

- Identify persons with experience in infection control and the epidemiology of MDRO, either in house or through outside consultation, for assessment of the local MDRO problem and for the design, implementation, and evaluation of appropriate control measures (27).
- Incorporation of infection control practices into patient and organizational safety programs.
- Provision of fiscal and human resources to maintain infection control and occupational health programs responsive to emerging needs.
- An infrastructure to guide, support and monitor adherence to infection control practices.

- Policies and procedures that explain how Standard and Transmission-based Precautions will be applied and enforced.
- Create systems to identify and communicate information about patients with potentially transmissible infectious agents.
- Methods to provide feedback to healthcare personnel and senior administrators.

2. Infection Control Measures

Infection control measures are the cornerstone of prevention in all settings at all times. Factors associated with transmission of all organisms including MDROs can be categorized into the 3 "C" framework of prevention principles (28):

- Contained
- Cooperative
- Clean

Two-Tiered Approach to MDRO Control

The control of MDROs is a dynamic process that requires a combination of control measures, and a systematic approach tailored to the problem and healthcare setting (27). NH is adopting the two-tiered approach to MDRO control found in Management of Multidrug Resistant Organisms in Healthcare Settings, 2006 (27) and is included as an appendix to this document. The first tier is the baseline level of activities that should be in place for all facilities. If an MDRO problem arises that cannot be controlled with the basic set of infection control measures, one or more additional measures should be selected and implemented from the second tier of interventions. Intensification of MDRO control activities could be triggered by several circumstances, including (27):

- Identification of an MDRO in a highly vulnerable patient population (i.e., ICU, burn unit) that has not previously had that MDRO.
- Failure to decrease the prevalence or incidence of a specific MDRO, despite infection control measures to stop its transmission.

Once interventions are implemented, ongoing surveillance and problem assessment should continue to determine if additional intervention or consultation is needed. The outcome should be reduction of MDRO levels to minimum levels.

Hand Hygiene

The single most effective means of reducing the potential for MDRO transmission is hand hygiene, including the use of soap and water, and alcohol-based gels (29, 23):

<http://www.cdc.gov/handhygiene/>

Precautions

Standard Precautions: Infection control practices that apply to the care of all patients, regardless of setting or known or suspected diagnosis or infection status. All blood, body fluid, secretions, excretions (except sweat), non-intact skin and mucous membranes may contain transmissible infectious agents. Personal protective

equipment (PPE)/barriers should be in place (see Table 2) (23, 27). Hand hygiene is a part of standard precautions.

Table 2: Standard Precautions

COMPONENT	RECOMMENDATIONS
Hand hygiene	After touching blood, body fluids, secretions, excretions, contaminated items; immediately after removing gloves; between patient contacts
Personal Protective Equipment --Gloves	For touching blood, body fluids, secretions, excretions, contaminated items; for touching mucous membranes and non-intact skin
--Mask, eye protection, face shield	During procedures and patient-care activities likely to generate splashes of blood, body fluids, secretions
--Gown	During procedures and patient-care activities when contact of clothing/exposed skin with blood/body fluids, secretions, and excretions are anticipated
Soiled patient-care equipment	Handle in a manner that prevents transfer of microorganisms to others and to the environment; wear gloves if visibly contaminated; perform hand hygiene
Environmental control	Develop procedures for routine care, cleaning, and disinfection of environmental surfaces, especially frequently touched surfaces in patient-care areas
Textiles and laundry	Handle in a manner that prevents transfer of microorganisms to others and to the environment
Safe Injection Practices Needles and other sharps	Do not recap, bend, break, or hand-manipulate used needles; if recapping is required, use a one-handed scoop technique only; use safety features when available; place used sharps in puncture-resistant container Use sterile, single use, disposable needle & syringe for each injection given & prevention of contamination of injection equipment and medication
Practices for Special Lumbar Puncture Procedures	Use face mask when placing a catheter or injecting material into the spinal or epidural space
Patient resuscitation	Use mouthpiece, resuscitation bag, and other ventilation devices to prevent contact with mouth and oral secretions
Patient placement	Prioritize for single-patient room if patient is at increased risk of transmission, is likely to contaminate the environment, does not maintain appropriate hygiene, or is at increased risk of acquiring infection or developing adverse outcome following infection
Respiratory hygiene/cough etiquette (source containment of infectious respiratory secretions in symptomatic patients, beginning at initial point of encounter e.g., triage	Instruct symptomatic persons to cover mouth/nose when sneezing/coughing; use tissues and dispose in no-touch receptacle, observe hand hygiene after soiling of hands with respiratory secretions, wear surgical mask if tolerated or maintain spatial separation, >3 feet if possible

and reception areas in emergency departments and physician offices)	Wear face mask when caring for person with signs and symptoms of respiratory infection
Device Management	Use catheters and indwelling devices only if essential Use proper insertion and care protocols Assess the need for the device regularly and remove as soon as feasible

Transmission-based Precautions: are indicated when the route of transmission may not be completely interrupted by Standard Precautions alone. This includes Contact Precautions, Droplet Precautions, and Airborne Precautions. Use depends on the clinical symptoms or likely pathogens. Protective Environment precautions are not relevant to this document and will not be discussed.
http://www.cdc.gov/ncidod/dhqp/gl_isolation.html

Contact Precautions: reduce the risk of transmitting infectious agents by direct or indirect contact with an infectious person and the person's environment. This includes:

- Single patient room preferred.
- Spatial separation of patients ≥ 3 feet between beds in multi-patient rooms.
- The use of gloves and gown by any healthcare personnel and visitors for all interactions that may involve contact with the patient or patient's environment.
- Limiting transport and movement of patients outside of the room for medically necessary purposes.

Droplet Precautions: reduce the risk of droplet transmission of infectious agents, spread through close respiratory or mucous membrane contact with respiratory secretions. This includes:

- Single patient room preferred.
- Separation of patients ≥ 3 feet and the curtain drawn between beds in multi-patient rooms.
- The use of a surgical mask (not respirator) for close patient contact.
- Limiting transport and movement of patients outside of the room for medically necessary purposes. Patient should wear a surgical mask if tolerated. Observe Respiratory Hygiene/Cough Etiquette.

Airborne Precautions: reduce the risk of transmission of infectious agents that remain infectious while suspended in the air. Airborne Precautions require:

- An AIIR (Airborne Infection Isolation Room): single occupancy that meets the American Institute of Architects/Facility Guidelines Institute standards for AIIRs.

- Fit-tested NIOSH-approved N95 respirator for healthcare personnel.
- Limiting transport and movement of patients outside of the room for medically necessary purposes.
 - If transport is necessary, patient should wear surgical mask (not N95) and all skin lesions should be covered.
- Where Airborne Precautions cannot be implemented due to limited engineering resources in a facility (i.e., physician's offices, LTCF), the patient should wear a surgical mask, and be placed in a single room. Try to keep negative pressure relative to the surrounding area with door closed except for entry and exit. Transfer to AIIR as soon as possible.

Initiation of Transmission-based Precautions

Syndromic and Empiric Application

It is not possible to identify or confirm all infections in every situation. Use of appropriate Transmission-based Precautions when a patient develops signs and symptoms of a transmissible infection can reduce transmission opportunities. Contact precautions should be used for any patient who has:

- Wounds, lesions, or non-intact skin that cannot be covered fully or which have drainage that cannot be contained by dressings.
- Excretion of urine or stool that cannot be contained in incontinence products or urine or ostomy bags.

Droplet precautions should be used in addition to standard precautions when the patient has:

- Uncontained respiratory secretions.
- Unexplained fever and cough (as part of CDC's Respiratory Hygiene and Cough Etiquette).

Non-Syndromic Application

The identification of certain organisms may prompt Transmission-based Precautions, regardless of the clinical syndrome.

Contact and/or droplet precautions should be instituted when:

- Infection control personnel may decide that the identification of certain MDROs is epidemiologically important, especially in high risk setting (e.g. burn or intensive care units) and institute transmission-based precautions;
- MDRO infections have been epidemiologically linked to other patients or in outbreak situations;

- Contact Precautions for all patients colonized or infected with target MDROs in acute settings. Refer to Setting Specific Recommendations (page19) for other situations. (27)

Discontinuation of Transmission-based Precautions

The optimal duration of contact precautions for the colonization or infection of individuals with MDROs is undetermined (23, 27). Patients may remain colonized for long periods of time, shedding may be intermittent, and surveillance methods may not identify the return of an MDRO. The facility should have a policy that clearly states the criteria for discontinuing Transmission-based Precautions.

Options to consider include discontinuing precautions when the syndrome that prompted precautions is resolved:

- Repeatedly negative cultures.
- No acute infection or drainage.
- No risk factors to transmit to others.
- It may be prudent to assume MDRO colonization is indefinite, and manage accordingly.
- If active surveillance cultures are used to identify and isolate individuals with MDROs, then Contact Precautions would be used for the duration of the stay in that setting.

CDC recommendations state that in general, it seems reasonable to discontinue Contact Precautions when 3 or more cultures are repeatedly negative for the target MDRO over the course of a week or two, in a patient who has not received antibiotics for several weeks, especially in the absence of draining wounds, profuse respiratory secretions or evidence specifically implicating the patient in ongoing transmission of the MDRO within the facility (27)

When Transmission-based Precautions are discontinued, this should be communicated clearly to the patient, family and staff by noting in the medical record and removal of advising signs.

Patient Management in Hospital and Non-hospital Healthcare Settings

Placement of all Patients

Every facility should develop a plan for appropriate management of all patients, which may be prioritized for the application to the MDRO-colonized or infected patient, but logically applies to all (because our ability to detect colonization or infection is imperfect). This plan includes the principles that:

- A private room is always optimal. Give the highest priority to individuals who have conditions that may facilitate transmission (uncontrolled secretions or excretions).

- If a private room is not an option, cohort patients together who are infected or colonized with the *same* organism, but not infected or colonized with a different MDRO.
- If a private or cohort room is not an option, consider the care requirements as well as the cognitive and functional abilities of both the patient and the roommate:

Colonized/Infected Patient Should:	Roommate Should:
Have good hygiene	Be immunocompetent
Be able to follow instructions	Be cooperative (see definition on page 6)
Have drainage contained	Have no invasive devices (Foley, feeding tubes, trachs, drains, intervascular devices)
	Have intact skin

Patient Movement and Activities

- In any setting where healthcare is delivered, when the patient is out of the precaution room:
 - Consider the “3 Cs”: Ensure that the patient is *clean*, with drainage, secretions, and excretions *contained*, and is *cooperative* in any setting. Infected or colonized patients should be permitted to participate in activities if draining wounds are covered, bodily fluids are contained, and the patient observes good hygienic practices.
 - For MDRO colonized or infected patients without draining wounds, diarrhea, or uncontrolled secretions, establish ranges of permitted ambulation, socialization, and use of common areas based on their risk to other patients and on the ability of the colonized or infected patients to observe proper hand hygiene and other recommended precautions to contain secretions and excretions (27). If patient is not cooperative or cannot be cooperative then the staff washes the patients’ hands.
 - Patients’ hands should be cleaned upon leaving the room and anytime they become contaminated while out of their room. Alcohol hand gel is exceptionally useful in such settings.
 - Facilities should develop guidance to follow infection control measures if the patient leaves the precaution room when the risk for complications has outweighed the risk of not walking/ambulating.
 - Perform environmental cleaning after use as described in the Environmental Measures below.

3. Environmental Measures

- Standard facility procedures can be followed for cleaning patient rooms <http://www.cdc.gov/mmwr/preview/mmwrhtml/rr5210a1.htm> (30). Priority should be given to items and surfaces that could be implicated in transmission.
- Clean and disinfect surfaces and equipment, including items in close proximity to the patient (rails, tables) and frequently touched surfaces in the care environment (e.g., knobs, bathrooms, light switches, call lights, and phones [23, 27]).
- Frequency and intensity of cleaning depends on the case's level of hygiene and environmental contamination. Use of the Environmental Protection Agency (EPA) disinfectant for standard facilities is adequate.
- Disinfect reusable equipment (e.g., IV poles, cuffs, wheelchairs) and discard disposable equipment between patient use.
- When possible, items should be dedicated to the person who is on contact precautions as long as the person requires the items, and then cleaned and disinfected prior to reuse by another patient.
- Shared items found in common areas should be cleaned on a regular basis with an EPA and facility-approved disinfectant.
- In the absence of on-going transmission, a private bathroom is not necessary for patients colonized or infected with enteric MDROs, provided standard precautions, personal hygiene, hand hygiene and environmental cleaning are maintained (e.g., daily and when visibly soiled).
- Commodes should be dedicated to one patient, but it is preferred that the infected/colonized patient use a toilet to reduce environmental contamination and exposure to infectious materials by healthcare workers.
- Showers, tubs, and whirlpools should be cleaned and disinfected between patient use, per standard facility procedure.
- Follow standard facility procedures for trash disposal per the NH Department of Environmental Services Waste Management Division. No additional or special handling is necessary.
- Standard precautions also apply for laundry. No additional or special handling is necessary.
- No special precautions are needed for dietary, food service, and eating utensils. The combination of hot water and detergents used in industrial dishwashers is sufficient to sanitize such items.

4. Setting Specific Recommendations

A goal of these guidelines is to standardize the foundation/framework for approaches to MDRO prevention and control across the State, regardless of healthcare setting or whether colonization or infection. In the two-tier approach (see Appendix) there are recommendations specific to certain

healthcare settings. Approaches should be selected based on the facility assessment, prevalence of the MDRO, and feasibility of implementation. Consider the nature of the interaction, the risk of transmission or on-going transmission, patient risk factors and the type of care provided.

- **Long Term Care, Residential Settings, Residential Rehabilitation Settings, Specialty Hospitals, and Hospice Centers:**
 - The patient management in hospital and non-hospital healthcare settings section on page 18 applies to this setting.
 - Problem solve and adapt guidelines to the specific situation
 - For MDRO colonized or infected patients without draining wounds, diarrhea, or uncontrolled secretions, establish ranges of permitted ambulation, socialization, and use of common areas based on their risk to other patients and on the ability of the colonized or infected patients to observe proper hand hygiene and other recommended precautions to contain secretions and excretions (27). If patient is not cooperative or cannot be cooperative then the staff washes the patients' hands.
 - Use the 3 Cs to allow rehabilitation and group activities outside the room (see Infection Control Measures section above).
- **Ambulatory Care Settings – Clinics, Physician Offices, Out-Patient Rehabilitation:**
 - The patient management in hospital and non-hospital healthcare settings section on page 18 applies to this setting.
 - Standard Precautions and appropriate PPE: Ensure gloves and gowns are used for uncontrolled secretions, draining wounds, ostomy tubes, bags, etc.
 - Source containment: Patients with overt signs and symptoms of infection should spend as little time as possible in common waiting areas.
 - Sit separately from other patients.
 - Place into exam room as soon as possible.
 - When feasible give them the last appointment of the day, or before a break to allow cleaning time.
 - Any surfaces or equipment that may have been in contact with the patient (e.g., blood pressure cuffs, examination table, stethoscopes) should be cleaned with an EPA- and facility-approved disinfectant prior to use for another patient.
 - Use the 3 Cs to guide patient management (see Infection Control Measures section above).
- **Dialysis Centers:** In hemodialysis units, follow the Recommendations to Prevent Transmission of Infections in Chronic Hemodialysis Patients (31) (www.cdc.gov/mmwr/PDF/rr/rr5005.pdf).
- **Medical Transport:** Standard precautions and usual vehicle cleaning routines are adequate to transport patients with MDROs. This includes Respiratory Etiquette and use of mask if needed for respiratory infections/uncontained secretions.
- **Home Healthcare and Home Hospice:** Risk of transmission is possible in this setting, (32). Home healthcare workers should focus on preventing cross transmission via their

clinical bag, clothing and any equipment that is carried to and from the patient's home. This can be accomplished by:

- Adhering to Standard Precautions and using disposable items.
- Cleaning or bagging reusable equipment prior to leaving the patient's home for cleaning and disinfection before use on another patient. Leave equipment in the home until patient is discharged from home care services. Clean and disinfect equipment prior to re-issuing to another patient's home.
- Applying Standard Precautions and hand hygiene are the basic minimum and should be applied universally. Explain standard precaution and the use of gloves when handling secretions and excretions and hand hygiene during and after care to family and patient.
- Discarding any disposable articles contaminated with secretions including soiled dressings, tissues, etc. in a red biohazard bag and dispose in the patient's routine trash.
- In the home:
 - Provide the following information and education:
 - No sharing of personal items (e.g., razors, towels, bar soap).
 - Patients are in their own environment and not with other patients and other germs. Risk of transmission has not been quantified (23).
 - Prompt and regular cleaning of all surfaces contaminated by secretions, excretions or touched by contaminated hands is important.
 - Family members that are immunosuppressed or very ill should not have contact with MDRO secretions/excretions and should promptly wash their hands if they have contact.
 - No special procedures are necessary for home laundry.
- **Non-Healthcare Settings**
 - **Schools**
 - Use the 3 C's to guide individual management for medical needs in non-healthcare settings.
 - Alert anyone with close physical contact of the infection if there has or could have been skin/lesion contact.
 - Report lesions to the school nurse, athletic director and follow up with primary care provider as soon as possible.
 - Cover wound/lesions. No contact sports if unable to cover, or cover won't stay in place during activity. May be excluded from school if uncontained.
 - Dressings can be discarded in regular trash.
 - Hand and personal hygiene: shower daily and after sports practice. Soap and/or alcohol based hand sanitizer is fine for hand washing. Wash after contact, and before leaving home. Use a new towel each time to dry.

- Don't share personal items such as towels, razors, ointments/balms, clothing, uniforms, or personal sports equipment.
 - Disinfect shared sports equipment after each use.
 - Change linens after use and right away if soiled.
 - Regular laundry cycle/soap is fine. Use the dryer if possible.
 - Dishes do not need special handling. Hot water and detergent or dishwashers are adequate.
 - Environmental cleaning: can use EPA registered disinfectant appropriate for MDROs or diluted bleach in water (*2T/gallon or 1 tsp per quart which is 1:100*) (*5T/ gallon is 1:50 prepared fresh & used w/in 24hrs is the dilution for norovirus*).
 - Facilities do not need to be closed for cleaning. Daily or frequent facility cleaning and an emphasis on hand hygiene will decrease transmission opportunities.
- **Workplace**
 - Consider types of interaction with the public and co-workers, shared computers, phone or other equipment and accessibility of hand hygiene opportunities and implement the 3 C's to guide individual management and environmental cleaning.
 - **Daycare or Adult Care Centers**
 - Follow recommendations for Schools (above).
 - Use the 3 C's to guide individual management. Clean frequently, especially if there is sharing of toys or common items applies. Hand hygiene should be emphasized.
 - Contact Childcare Licensing for diaper recommendations, etc.
 - **Correctional Facilities**
 - Follow recommendations for Long Term Care, Residential Settings, Residential Rehabilitation Settings, Specialty Hospitals, and Hospice Centers Setting (above) tailored to the specific needs of the population. Specific guidance on MRSA is available (33).

D. The Prevention of Infection by MDROs

Applying approaches to preventing all infections will also reduce MDRO infection rates. Patients are vulnerable to colonization and infection from severe disease or underlying medical conditions, recent surgery or procedures. Prevention of infection depends on appropriate clinical practices that are incorporated into all routine care. These include device management (preventing pneumonia in intubated patients, blood stream infections and urinary tract infections from indwelling devices), avoiding aspiration, using antimicrobials wisely (targeting likely or known pathogens, optimizing timing and duration of administration). Source control (respiratory/cough etiquette, hand hygiene,

wound debridement,) as well as skin care and prevention of pressure ulcers. Standard precautions, however, remain as the foundation.

1. Education and Communication

- **Within the facility:** Each facility should establish a system of flagging medical and electronic records of patients who need transmission-based precautions so that all staff involved in care are notified prior to transfer and appropriate infection control protocols/precautions can be put in place. Identifying persons at the time of readmission to the facility can assist the admissions department and nursing personnel to implement special precautions promptly. This measure requires some indication in the patient's medical record and/or computer file, which is accessed at the time of admission. Any such system must maintain patient confidentiality.
- **With other facilities:** Effective communication between facilities involved in patient transfer is important to ensure that the transmission-based precautions needed for a patient are known and that appropriate precautions are instituted and maintained in both facilities. It is the responsibility of the facility transferring the patient to inform the receiving unit/facility and the EMS transport or transfer personnel of the patient's need for transmission based precaution prior to treatment or transfer. When a patient is found to be infected or colonized with MDROs within 48 hours of admission, the receiving facility should inform the transferring institution. Persons with MDROs should NOT be denied hospital and/or long-term care facility admission solely on the basis of a positive MDROs culture (6, 34).
- **Staff education:** Continuing education programs for staff who have direct contact with patients or items in their environment is strongly encouraged. Staff who are responsible for making decisions regarding the care and placement of patients should also receive information about the risk and prevention of MDROs. It is important that healthcare workers who have direct contact with patients on contact precautions be made aware of appropriate control measures (e.g., PPE) prior to room entry. Ideally, such education should be part of orientation and ongoing, regular education.
- **Patient, family, and visitor education:** Patients, families, and visitors should be educated about MDROs, necessary precautions, and their own potential for colonization. For example, patients should be instructed to cover their mouths when coughing, to practice good hand hygiene, and to not share drinks, food, or personal items, like razors or nail clippers. Patients on isolation and their families need additional education, including the reason for isolation, control measures, and expected duration of isolation. Family and visitors need to comply with precautions – hand washing when entering and leaving the room, use of gowns and gloves, and their proper removal. Family members should be advised that healthy members have little risk of developing an infection due to MDROs.

2. Surveillance

Routine collection of active surveillance cultures of all patients for MDROs (i.e., at admission) is not recommended by the NH DHHS or the CDC. Active surveillance cultures are a snapshot, as

body flora is dynamic. Therefore, active surveillance cultures are not warranted (37). Screening high-risk patients may be indicated in certain situations:

- In certain settings such as, burn units and intensive care units, and in certain pre-operative procedures as determined by the facility infection control;
- Healthcare associated patients with risk factors described in the background of this document;
- Healthcare personnel should be cultured only if epidemiologic data implicates them as a possible source of transmission. (27)

Diagnostic cultures are recommended when there is reason to suspect an infection or possible source of dissemination of MDROs:

- Stool, rectal, or perirectal swab culture in patients with a history of VRE or contact with VRE patients.
- Nasal, perirectal, or wound culture in patients with a history of MRSA or contact with MRSA patients.
- Infection site culture with directed susceptibility testing for VRSA/VISA in a patient with a history of extensive vancomycin use failing vancomycin therapy for MRSA.

For those facilities choosing to conduct active or passive surveillance systems, then surveillance should include regular laboratory based systems to detect and communicate evidence of MDROs in clinical isolates (27). As part of a surveillance system facilities should:

- Establish laboratory-based systems to detect and communicate evidence of MDROs in clinical isolates;
- Establish systems to ensure that clinical micro labs (in-house and outsourced) promptly notify infection control or a designee when a novel resistance pattern for the facility is detected;
- Prepare facility-wide antimicrobial susceptibility reports (antibiogram) and monitor reports for evidence of changing resistance that may indicate emergence or transmission of MDROs, and develop and monitor special-care unit-specific antimicrobial susceptibility reports (e.g., ventilator-dependent units, ICUs, oncology units) if indicated;
- Monitor trends in incidence of target MDROs in the facility over time to determine if MDRO rates are decreasing or if additional interventions are needed. (27)

3. Decolonization

Decolonization entails treatment of persons colonized with a specific MDRO to eradicate carriage of that organism. Routinely attempting decolonization of MDROs is not recommended because:

- 1) Efficacy is questionable. For example, MRSA recolonization is common after treatment and there is no clinically proven decolonization regimen for VRE;
- 2) Attempts at decolonization may result in emergence of additional resistance to the agents used;

3) Decolonization has little impact on the long-term incidence of infections. (6,35,36)

NH DHHS recommends limiting the use of decolonization to outbreaks or other high prevalence situations, especially those affecting special-care units (27). Healthcare professionals implicated in transmission of MRSA are candidates for decolonization and should be treated and culture negative before returning to direct patient care (27). Yet, healthcare professionals who are colonized with MRSA, but are asymptomatic, and have not been linked epidemiologically to transmission, do not require decolonization (27).

4. Animals and MDROs in Hospital Healthcare Settings

Animals can serve as sources of zoonotic pathogens that could potentially infect patients and healthcare workers. Transmission between animals and humans, and vice versa, has been reported for several MDROs (i.e., MRSA, VRE), although the frequency of such transmission is unclear. Similar to people, animals may be symptomatic or asymptomatic carriers of MDROs. Although evidence is not conclusive in the role animals play in transmission, MDRO protocols should address requirements and procedures for animal visitation and co-habitation in hospital healthcare settings.

General guidelines exist for animals in healthcare facilities (30). Requirements for animals visiting healthcare facilities are important in decreasing transmission of pathogens including MDROs. Such requirements may include:

- Ensuring the animal is in good health without open wounds or obvious dermatologic lesions.
- Strict enforcement of hand-hygiene measures after animal contact.
- Use of barrier protective measures.
- Possibly excluding animals from special care areas (e.g., burn units).

Animals diagnosed with MDROs may be excluded from healthcare facilities. Many of the principles and precautions used for decreasing transmission from human patients are also appropriate for animals diagnosed with MDROs, including:

- Appropriate wound care and coverings.
- Strict hand-hygiene.
- Barrier protective measures when touching items such as the animal's bedding, bandages or any other objects that may have been in contact with the infected areas.
- Appropriate disinfection of bedding and environmental surfaces.
- Restricting contact with immunocompromised individuals.

III. MDRO Outbreak Management

To classify a cluster of MDRO cases as an outbreak, the situation must have:

- Presence of active transmission or evidence of biologically plausible transmission.
- Presence of clinical illness related to the organism.

The primary goals of outbreak management are to:

- Control and prevent further disease.

- Identify factors that contributed to the outbreak.
- Develop and implement measures to prevent further outbreaks in the future.
- Education

By New Hampshire state statute RSA 141-C, healthcare providers as well as laboratories shall report to the Bureau of Communicable Disease Control (BCDC) any cluster of illness within 24 hours.

- During normal business hours reports shall be made to the BCDC at phone number (603)-271-4496 or fax number (603)-271-0545. After normal business hours or on weekends, the phone report shall be made to the New Hampshire Hospital switchboard at 1-800-852-3345 to request the BCDC Public Health Nurse on call.
- Working in conjunction with the BCDC, an action plan following Tier 2 Recommendations will be developed to:
 - Initiate and maintain a line listing.
 - Determine whether or not additional surveillance techniques are warranted. It may be appropriate in these situations to culture employees and patients to search for unidentified cases.
 - Review the role of antimicrobial use in the MDRO outbreak.
 - Reinforce infection control practices that may include instituting transmission-based precautions.
 - Cohort patients/staff.
 - Keep ill staff home until well.
 - Educate healthcare workers and the public.
 - Decolonize carriers if recommended or proven effective.
 - Decolonize and restrict from work any colonized healthcare workers implicated in transmission.
 - Implement patient-dedicated use of non-critical equipment.
 - Clean and disinfect the environment and equipment.
 - Rooms where patients are on transmission based precautions should follow HICPAC guidance on proper cleaning methods.

REFERENCES

1. Wilson SJ, Knipe CJ, Zieger MJ, Gabehart KM, Goodman JE, Volk HM, Sood R. Direct costs of multidrug-resistant *Acinetobacter baumannii* in the burn unit of a public teaching hospital. *Am J Infect Control*. 2004; 32:342-344.
2. Qavi A, Segal-Maurer S, Mariano N, Urban C, Rosenberg C, Burns J, Chiang T, Maurer J, Rahal JJ. Increased mortality associated with a clonal outbreak of ceftazidime-resistant *Klebsiella pneumoniae*: a case-control study. *Infect Control Hosp Epidemiol*. 2005;26:63-68.
3. Song X, Srinivasan A, Plaut D, Perl TM. Effect of Nosocomial Vancomycin-Resistant Enterococcal Bacteremia on Mortality, Length of Stay, and Costs. *Infect Control Hosp Epidemiol*. 2003; 24:251-256.
4. Kollef MH, Fraser VJ. Antibiotic resistance in the intensive care unit. *Ann Intern Med*. 2001;134: 298-314.
5. Fridkin SK. Increasing prevalence of antimicrobial resistance in intensive care units. *Crit Care Med*. 2001;29:N64-68.
6. Strausbaugh LJ, Crossley KB, Nurse BA, Thrupp LD. Antimicrobial Resistance in Long-Term-Care Facilities. *Infect Control Hosp Epidemiol*. 1996; 17:129-140.
7. Ben-Ami R, Schwaber MJ, Navon-Venezia S, et al. Influx of extended-spectrum beta-lactamase-producing enterobacteriaceae into the hospital. *Clin Infect Dis*. 2006;42:925-934.
8. Elizaga ML, Weinstein RA, Hayden MK. Patients in long-term care facilities: a reservoir for vancomycin-resistant enterococci. *Clin Infect Dis*. 2002; 34:441-446.
9. Bradley, S.F., Terpenning, M.S., Ramesy, M.A., et al. Methicillin-Resistant *Staphylococcus aureus*: Colonization and Infection in a Long-Term Care Facility. *Ann Intern Med*. 1991; 115:417-422.
10. Strausbaugh, L.J., Jacobson, C., Sewell, D.L., et al. Methicillin-Resistant *Staphylococcus aureus* in Extended-Care Facilities. *Infect Control Hosp Epidemiol*. 1991; 12:36-45.
11. Bonilla, H.F., Zervos, M.A., Lyons, M.J., et al. Colonization with Vancomycin-Resistant *Enterococcus faecium*: Comparison of a Long-Term-Care Facility with an Acute Care Hospital. *Infect Control Hosp Epidemiol*. 1997; 18:333-339.
12. Bradley, S.F. Issues in the Management of Resistant Bacteria in Long-Term-Care Facilities. *Infect Control Hosp Epidemiol*. 1999; 20:362-366.
13. CDC. Methicillin-Resistant *Staphylococcus aureus* Infections Among Competitive Sports Participants--Colorado, Indiana, Pennsylvania, and Los Angeles County, 2000-2003. *MMWR* 2003; 52(33):793-795.

14. CDC. Methicillin-Resistant *Staphylococcus aureus* Infections in Correctional Facilities--Georgia, California and Texas, 2001-2003. *MMWR* 2003;52(41):992-996.
15. Adcock P, Pastor P, Medley F, Patterson J, Murphy T. Methicillin-resistant *Staphylococcus aureus* in two childcare centers. *J Infect Dis* 1998;178:577-80.
16. Zinderman CE, Conner B, Malakooti MA, LaMar JE, Armstrong A, Bohnker BK. Community-acquired methicillin-resistant *Staphylococcus aureus* among military recruits. *Emerg Infect Dis*. 2004; 10(5); 941-944.
17. Fridkin SK, Hageman JC, Morrison M, et al. Methicillin-Resistant *Staphylococcus aureus* Disease in Three Communities. *N Engl J Med*. 2005;352:1436-1444.
18. Moran GJ, Krishnadasan A, Gorowitz R, Fosheim G, McDougal LK, Carey RB, Talan D. Methicillin-Resistant *S. aureus* Infections among Patients in the Emergency Department. *N Engl J Med*. 2006;355:666-674.
19. Klevens RM, Morrison MA, Nadle J, et al. Invasive Methicillin-Resistant *Staphylococcus aureus* Infections in the United States. *JAMA*. 2007; 298:1763-1771.
20. Muto, C.A., Jernigan, J.A., Ostrowsky, B.E., Richet, H.M., Jarvis, W.R., Boyce, J. M., Farr, B. M. SHEA Guideline for Preventing Nosocomial Transmission of Multidrug-Resistant Strains of *Staphylococcus aureus* and *Enterococcus*. *Infect Control Hosp Epidemiol*. 2003; 24:362-386.
21. Nicolle, L.E., Bentley, D., Garibaldi, R., et al. SHEA Position Paper: Antimicrobial Use in Long-Term-Care Facilities. *Infect Control Hosp Epidemiol*. 2000; 21:534-545.
22. Hospital Infection Control Practices Advisory Committee (HICPAC). Recommendations for Preventing the Spread of Vancomycin Resistance: Recommendation of the Hospital Infection Control Practices Advisory Committee. *Am J Infect Control*. 1995; 23:87-94 and also in *MMWR* 1995; 44 (RR-12):1-13.
23. Siegel JD, Rhinehart E, Jackson M, Chiarello L, and the Healthcare Infection Control Practices Advisory Committee. 2007 Guideline for Isolation Precautions: Preventing Transmission of Infectious Agents in Healthcare Settings. June 2007. Available at: http://www.cdc.gov/ncidod/dhqp/gl_isolation.html
24. Muto, C.A., M.D., M.S., et al. SHEA Guideline for Preventing Nosocomial Transmission of Multidrug -Resistant Strains of *Staphylococcus aureus* and *Enterococcus*. *Infect Control Hosp Epidemiol*. 2003;24:367.
25. Davis, K. A., Stewart, J. J., Crouch, H. K., Florez, C. E., & Hospenthal, D. R. (2004) *Clin Infect Dis* 39, 776-782.
26. Muder, R. R., Brennen, C., Wagener, M. M., Vickers, R. M., Rihs, J. D., Hancock, G. A., Yee, Y. C., Miller, J. M., & Yu, V. L. (1991) *Ann Intern Med* 114, 107-112.

27. Siegel JD, Rhinehart E, Jackson M, Chiarello L, and the Healthcare Infection Control Practices Advisory Committee. Management of Multidrug-Resistant Organisms in Healthcare Settings, HICPAC Advisory Committee. October 2006.
28. Brinsley-Rainisch KJ, Cochran RL, Bush-Knapp ME, Pearson ML, and the Get Smart: Know When Antibiotics Work Team. (2007) *AJIC* 35(6), 425-426.
29. CDC. Guideline for Hand Hygiene in Health-Care Settings. Recommendations of the Healthcare Infection Control Practices Advisory Committee and the HICPAC/SHEA/APIC/IDSA Hand Hygiene Task Force. *MMWR* 2002;51(RR-16): 1-44. <http://www.cdc.gov/handhygiene>
30. CDC. Guidelines for Environmental Infection Control in Health-Care Facilities: Recommendations of CDC and the Healthcare Infection Control Practices Advisory Committee (HICPAC). *MMWR* 2003;52 (RR10): 1-42.
31. CDC. Recommendations to Prevent Transmission of Infections Among Chronic Hemodialysis Patients. *MMWR* 2001;50 (RR05): 1-43.
32. Rhinehart E and McGoldrick M. *Infection Control in Home Care and Hospice* (second ed) Boston: Jones and Bartlett Publishers. 2006: 94.
33. Management of Methicillin-Resistant *Staphylococcus Aureus* (MRSA) Infections: Federal Bureau of Prisons-Clinical Practice Guidelines. August 2005. Available at: <http://www.bop.gov/news/PDFs/mrsa.pdf>.
34. *J Am Geriatric Soc.* 2000; 48(10):1211-5.
35. Boyce, J.M., Jackson, M.M., Pugliese, G., et. al. Methicillin-Resistant *Staphylococcus aureus* (MRSA): A Briefing for Acute Care Hospitals and Nursing Facilities. *Infect Control Hosp Epidemiol.* 1994; 15:105-115.
36. Strausbaugh, L.J., Jacobson, C., Sewell, D.L., et al. Antimicrobial Therapy for Methicillin-Resistant *Staphylococcus aureus* Colonization in Residents and Staff of a Veteran's Affairs Nursing Home Care Unit. *Infect Control Hosp Epidemiol.* 1992; 13:151-159.
37. Harbarth, E., Fankhauser, C., et al. Universal Screening for Methicillin-Resistant *Staphylococcus Aureus* at Hospital Admission and Nosocomial Infection in Surgical Patients. *JAMA.* 2008; 299(10): 1149-1157

Appendix: Two-Tiered Approach to MDRO Control

Tier 1. General Recommendations for Routine Prevention and Control of MDROs in Healthcare Settings

Administrative Measures/Adherence Monitoring	MDRO Education	Judicious Antimicrobial Use	Surveillance	Infection Control Precautions to Prevent Transmission	Environmental Measures	Decolonization
<p>Make MDRO prevention/control an organizational priority. Provide administrative support and both fiscal and human resources to prevent and control MDRO transmission. <i>(IB)</i></p> <p>Identify experts who can provide consultation and expertise for analyzing epidemiologic data, recognizing MDRO problems, or devising effective control strategies, as needed. <i>(II)</i></p> <p>Implement systems to communicate information about reportable MDROs to administrative personnel and state/local health departments. <i>(II)</i></p> <p>Implement a multi-disciplinary process to monitor and improve HCP adherence to recommended practices for Standard and Contact Precautions. <i>(IB)</i></p> <p>Implement systems to designate patients known to be colonized or infected with a targeted MDRO and to notify receiving healthcare facilities or personnel prior to transfer of such patients within or between facilities. <i>(IB)</i></p> <p>Support participation in local, regional and/or national coalitions to combat emerging or growing MDRO problems. <i>(IB)</i></p> <p>Provide updated feedback at least annually to healthcare providers and administrators on facility and patient-care unit MDRO infections. Include information on changes in prevalence and incidence, problem assessment and performance improvement plans. <i>(IB)</i></p>	<p>Provide education and training on risks and prevention of MDRO transmission during orientation and periodic educational updates for HCP; include information on organizational experience with MDROs and prevention strategies. <i>(IB)</i></p>	<p>In hospitals and LTCFs, ensure that a multi-disciplinary process is in place to review local susceptibility patterns (antibiograms), and antimicrobial agents included in the formulary, to foster appropriate antimicrobial use. <i>(IB)</i></p> <p>Implement systems (e.g., CPOE, susceptibility report comment, pharmacy or unit director notification) to prompt clinicians to use the appropriate agent and regimen for the given clinical situation. <i>(IB)</i></p> <p>Provide clinicians with antimicrobial susceptibility reports and analysis of current trends, updated at least annually, to guide antimicrobial prescribing practices. <i>(IB)</i></p> <p>In settings with limited electronic communication system infrastructures to implement physician prompts, etc., at a minimum implement a process to review antibiotic use. Prepare and distribute reports to providers. <i>(II)</i></p>	<p>Use standardized laboratory methods and follow published guidelines for determining antimicrobial susceptibilities of targeted and emerging MDROs.</p> <p>Establish systems to ensure that clinical micro labs (in-house and outsourced) promptly notify infection control or a medical director/designee when a novel resistance pattern for that facility is detected. <i>(IB)</i></p> <p>In hospitals and LTCFs:</p> <p>...develop and implement laboratory protocols for storing isolates of selected MDROs for molecular typing when needed to confirm transmission or delineate epidemiology of MDRO in facility. <i>(IB)</i></p> <p>...establish laboratory-based systems to detect and communicate evidence of MDROs in clinical isolates <i>(IB)</i></p> <p>...prepare facility-specific antimicrobial susceptibility reports as recommended by CLSI; monitor reports for evidence of changing resistance that may indicate emergence or transmission of MDROs <i>(IA/IC)</i></p> <p>...develop and monitor special-care unit-specific antimicrobial susceptibility reports (e.g., ventilator-dependent units, ICUs, oncology units). <i>(IB)</i></p> <p>...monitor trends in incidence of target MDROs in the facility over time to determine if MDRO rates are decreasing or if additional interventions are needed. <i>(IA)</i></p>	<p>Follow Standard Precautions in all healthcare settings. <i>(IB)</i></p> <p>Use of Contact Precautions (CP):</p> <p>--- In <i>acute care settings</i> : Implement CP for all patients known to be colonized/infected with target MDROs. <i>(IB)</i></p> <p>--- In <i>LTCFs</i>: Consider the individual patient's clinical situation and facility resources in deciding whether to implement CP <i>(II)</i></p> <p>--- In <i>ambulatory and home care settings</i>, follow Standard Precautions <i>(II)</i></p> <p>---In <i>hemodialysis units</i>: Follow dialysis specific guidelines <i>(IC)</i></p> <p>No recommendation can be made regarding when to discontinue CP. <i>(Unresolved issue)</i></p> <p>Masks are not recommended for routine use to prevent transmission of MDROs from patients to HCWs. Use masks according to Standard Precautions when performing splash-generating procedures, caring for patients with open tracheostomies with potential for projectile secretions, and when there is evidence for transmission from heavily colonized sources (e.g., burn wounds).</p> <p>Patient placement in hospitals and LTCFs:</p> <p>When single-patient rooms are available, assign priority for these rooms to patients with known or suspected MDRO colonization or infection. Give highest priority to those patients who have conditions that may facilitate transmission, e.g., uncontained secretions or excretions. When single-patient rooms are not available, cohort patients with the same MDRO in the same room or patient-care area. <i>(IB)</i></p> <p>When cohorting patients with the same MDRO is not possible, place MDRO patients in rooms with patients who are at low risk for acquisition of MDROs and associated adverse outcomes from infection and are likely to have short lengths of stay. <i>(II)</i></p>	<p>Follow recommended cleaning, disinfection and sterilization guidelines for maintaining patient care areas and equipment.</p> <p>Dedicate non-critical medical items to use on individual patients known to be infected or colonized with an MDRO. Prioritize room cleaning of patients on Contact Precautions. Focus on cleaning and disinfecting frequently touched surfaces (e.g., bed rails, bedside commodes, bathroom fixtures in patient room, doorknobs) and equipment in immediate vicinity of patient.</p>	<p>Not recommended routinely</p>

Tier 2. Recommendations for Intensified MDRO control efforts

Institute one or more of the interventions described below when 1) incidence or prevalence of MDROs are not decreasing despite the use of routine control measures; or 2) the *first* case or outbreak of an epidemiologically important MDRO (e.g., VRE, MRSA, VISA, VRSA, MDR-GNB) is identified within a healthcare facility or unit *(IB)* Continue to monitor the incidence of target MDRO infection and colonization; if rates do not decrease, implement additional interventions as needed to reduce MDRO transmission.

Administrative Measures/Adherence Monitoring	MDRO Education	Judicious Antimicrobial Use	Surveillance	Infection Control Precautions to Prevent Transmission	Environmental Measures	Decolonization
<p>Obtain expert consultation from persons with experience in infection control and the epidemiology of MDROs, either in-house or through outside consultation, for assessment of the local MDRO problem and guidance in the design, implementation and evaluation of appropriate control measures. <i>(IB)</i></p> <p>Provide necessary leadership, funding and day-to-day oversight to implement interventions selected. <i>(IB)</i></p> <p>Evaluate healthcare system factors for role in creating or perpetuating MDRO transmission, including staffing levels, education and training, availability of consumable and durable resources; communication processes, and adherence to infection control measures. <i>(IB)</i></p> <p>Update healthcare providers and administrators on the progress and effectiveness of the intensified interventions. <i>(IB)</i></p>	<p>Intensify the frequency of educational programs for healthcare personnel, especially for those who work in areas where MDRO rates are not decreasing. Provide individual or unit-specific feedback when available. <i>(IB)</i></p>	<p>Review the role of antimicrobial use in perpetuating the MDRO problem targeted for intensified intervention. Control and improve antimicrobial use as indicated. Antimicrobial agents that may be targeted include vancomycin, third-generation cephalosporins, antianaerobic agents for VRE; third generation cephalosporins for ESBLs; and quinolones and carbapenems. <i>(IB)</i></p>	<p>Calculate and analyze incidence rates of target MDROs (single isolates/patient; location-, service-specific) <i>(IB)</i></p> <p>Increase frequency of compiling, monitoring antimicrobial susceptibility summary reports <i>(II)</i></p> <p>Implement laboratory protocols for storing isolates of selected MDROs for molecular typing; perform typing if needed <i>(IB)</i></p> <p>Develop and implement protocols to obtain active surveillance cultures from patients in populations at risk. <i>(IB)</i> (See recommendations for appropriate body sites and culturing methods.)</p> <p>Conduct culture surveys to assess efficacy of intensified MDRO control interventions.</p> <p>Conduct serial (e.g., weekly) unit-specific point prevalence culture surveys of the target MDRO to determine if transmission has decreased or ceased. <i>(IB)</i></p> <p>Repeat point-prevalence culture-surveys at routine intervals and at time of patient discharge or transfer until transmission has ceased. <i>(IB)</i></p> <p>If indicated by assessment of the MDRO problem, collect cultures to assess the colonization status of roommates and other patients with substantial exposure to patients with known MDRO infection or colonization. <i>(IB)</i></p> <p>Obtain cultures from HCP for target MDROs when there is epidemiologic evidence implicating the staff member as a source of ongoing transmission.</p>	<p>Use of Contact Precautions: Implement Contact Precautions (CP) routinely for all patients colonized or infected with a target MDRO. <i>(IA)</i> Don gowns and gloves before or upon entry to the patient's room or cubicle. <i>(IB)</i> In LTCFs, modify CP to allow MDROcolonized/infected patients whose site of colonization or infection can be appropriately contained and who can observe good hand hygiene practices to enter common areas and participate in group activities When active surveillance cultures are obtained as part of an intensified MDRO control program, implement CP until the surveillance culture is reported negative for the target MDRO <i>(IB)</i> No recommendation is made for universal use of gloves and/or gowns. <i>(Unresolved issue)</i> Implement policies for patient admission and placement as needed to prevent transmission of the problem MDRO. <i>(IB)</i> When single-patient rooms are available, assign priority for these rooms to patients with known or suspected MDRO colonization or infection. Give highest priority to those patients who have conditions that may facilitate transmission, e.g., uncontained secretions or excretions. When single-patient rooms are not available, cohort patients with the same MDRO in the same room or patient-care area. <i>(IB)</i> When cohorting patients with the same MDRO is not possible, place MDRO patients in rooms with patients who are at low risk for acquisition of MDROs and associated adverse outcomes from infection and are likely to have short lengths of stay. <i>(II)</i> Stop new admissions to the unit or facility if transmission continues despite the implementation of the intensified control measures. <i>(IB)</i></p>	<p>Implement patient.-dedicated use of non-critical equipment <i>(IB)</i></p> <p>Intensify and reinforce training of environmental staff who work in areas targeted for intensified MDRO control. Some facilities may choose to assign dedicated staff to targeted patient care areas to enhance consistency of proper environmental cleaning and disinfection services <i>(IB)</i></p> <p>Monitor cleaning performance to ensure consistent cleaning and disinfection of surfaces in close proximity to the patient and those likely to be touched by the patient and HCWs (e.g., bedrails, carts, bedside commodes, doorknobs, faucet handles) <i>(IB)</i>.</p> <p>Obtain environmental cultures (e.g., surfaces, shared equipment) only when epidemiologically implicated in transmission <i>(IB)</i></p> <p>Vacate units for environmental assessment and intensive cleaning when previous efforts to control environmental transmission have failed <i>(II)</i></p>	<p>Consult with experts on a case-by-case basis regarding the appropriate use of decolonization therapy for patients or staff during limited period of time as a component of an intensified MRSA control program <i>(II)</i></p> <p>When decolonization for MRSA is used, perform susceptibility testing for the decolonizing agent against the target organism or the MDRO strain epidemiologically implicated in transmission. Monitor susceptibility to detect emergence of resistance to the decolonizing agent. Consult with microbiologists for appropriate testing for mupirocin resistance, since standards have not been established.</p> <p>Do not use topical mupirocin routinely for MRSA decolonization of patients as a component of MRSA control programs in any healthcare setting. <i>(IB)</i></p> <p>Limit decolonization to HCP found to be colonized with MRSA who have been epidemiologically implicated in ongoing transmission of MRSA to patients. <i>(IB)</i></p> <p>No recommendation can be made for decolonization of patients who carry VRE or MDRGNB.</p>